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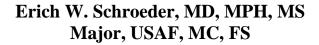
THE ASSOCIATION BETWEEN MENTAL HEALTH AND CIGARETTE SMOKING IN ACTIVE DUTY MILITARY MEMBERS

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14. ABSTRACT

The aim of this research project is to determine if a relationship exists between mental health disorders and cigarette smoking in active duty military members. If a relationship exists, this information could guide the formulation of policy and the development of programs to assist service members in smoking cessation and ultimately improved health and readiness. A cross-sectional prevalence study was conducted that includes descriptive statistics, univariate analysis, and multivariate logistic regression analysis of the association between any cigarette smoking during the past 30 days and four main predictors: need for further depression evaluation, reception of mental health treatment in the past 12 months, perceived need for mental health counseling in the past 12 months, and prescription of medications for depression or anxiety. The study population consisted of 16,146 active duty military members who responded to the 2005 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel. The results of the analysis showed that there is an association between mental health predictors and any smoking after controlling for a wide range of covariates. Active duty military members who may have a need for further depression evaluation, who have received mental health counseling, who felt they needed mental health counseling, and/or who have been prescribed mental health medication are more likely to have smoked at least one cigarette in the past 30 days. These findings, as well as subsequent research, could be applied in the development of smoking prevention and cessation programs.

15. SUBJECT TERMS

Cigarette smoking, mental health disorders, depression, smoking in the military

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1.0 INTRODUCTION

The aim of this research project is to determine if a relationship exists between mental health disorders and cigarette smoking in active duty military members using the 2005 Department of Defense (DoD) Survey of Health Related Behaviors (HRB) Among Active Duty Military Personnel. If a relationship exists, this information could be used in guiding the formulation of policy and the development of programs to assist service members in smoking cessation and ultimately improved health and readiness.

The Armed Forces consistently seek to have as fit of a force as possible to meet the ever-growing demands of serving in the military. This has become even more important since the September 11, 2001, terrorist attacks and the subsequent increased operations tempo supporting the wars in Iraq and Afghanistan as well as other military actions. These operations involve extended deployments and ever-increasing demands on service members and their families. Consequently, programs and policies created by the DoD to assist members in maximizing their effectiveness must be comprehensive and timely. This research may aid in the pursuit of this goal.

2.0 BACKGROUND

2.1 General Tobacco Use

2.1.1 Characteristics and Impact. Tobacco use is the single most preventable cause of death and disease in the United States. Approximately 21% of the U.S. population (approximately 45 million people) smoke cigarettes. Almost a quarter (23.9%) of the male population and almost one-fifth (18%) of the female population smoke cigarettes.   Approximately 400,000 people die each year from their own cigarette smoke (Ref 1). More deaths are attributable to cigarette smoking than to the Acquired Immune Deficiency Syndrome, homicide, suicide, motor vehicle accidents, substance abuse (including alcohol, heroin, and cocaine), and fires altogether (Ref 2). Further description of the medical and psychological deleterious effects of cigarette smoking is beyond the scope of this paper (see Ref 3). Smoking not only impacts the smoker but takes a heavy emotional and physical toll on families and friends and is associated with significant tobacco-related monetary costs and productivity losses.

2.1.2 General Tobacco Use Costs. As of 2006, the total annual public and private health care expenditures caused by smoking are $96.7 billion. The annual smoking-caused Medicaid costs to the Federal and State governments are $30.9 billion, while the Medicare costs are $27.4 billion. The annual health care expenditures solely from secondhand smoke exposure are almost $5 billion ($4.98 billion). Productivity losses caused by smoking are $97.6 billion each year (Ref 4).   These staggering costs are passed on to both smoking and nonsmoking taxpayers alike.

The taxpayers' yearly Federal and State tax burden from smoking-caused government spending is $70.7 billion or $630 per household (Ref 5). In practical terms, smoking-caused health costs and productivity losses per cigarette pack of 20 cigarettes sold in the U.S. (low estimate) are $10.28. The average retail price per pack in the U.S. (including sales tax) is $4.20 (Ref 6).

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2.1.3 Cigarette Smoking in Adolescents. Almost one-quarter of the high school students (14-18 years old) in the U.S. smoke, over one-third of the younger adolescents (11-13 years old) have tried smoking, and an estimated 28% of U.S. adolescents smoke on a regular basis (Ref 7). Only 10% of adult smokers begin smoking after the age of 18 years old (Ref 8). From 1991-1999, the prevalence of cigarette use among high school students increased. However, since 2001, smoking among teens has declined. Unfortunately, that decline has been slowing (Ref 9). In 2006, over half (54%) of the current high school smokers attempted to quit within the previous year (Ref 10). These attempts are challenging because of the characteristics of nicotine and the smoking habit.

2.1.4 Cigarette Addiction Characteristics. Cigarette smokers who want to quit find it extremely difficult to accomplish due to nicotine's very addictive nature, the associated habits developed while smoking, and its withdrawal symptoms. Research indicates nicotine is as addictive as heroin, cocaine, and alcohol and just as difficult to quit. Nicotine can act as both a stimulant and a depressant, depending on the dosage and timing of delivery, and has a variety of physiological actions (Ref 11). One of the key actions is to increase dopamine release in the nucleus accumbens, producing feelings of pleasure. The chronic use of nicotine up-regulates the neuronal nicotinic acetylcholine receptors and desensitizes these receptors, resulting in the user becoming dependent and eventually addicted to the nicotine (Ref 12). Studies have shown the average user becomes nicotine dependent within 2 years of initially smoking (Ref 1).

Smokers use cigarettes for a variety of reasons in addition to physiological addiction. Initial use may be due to peer pressure, boredom, or the excitement of something new. As the smoking habit develops, the user associates other actions with smoking, such as drinking coffee or drinking alcohol. These associated habits subsequently can make quitting more difficult. Another significant component of smoking cessation is the withdrawal symptoms. These symptoms include irritability, anxiousness, decreased concentration, nausea, dizziness, and headaches (Ref 11). As of 2000, 70% of current U.S. adult smokers want to quit smoking completely. More recently, approximately 44.2% of adult smokers (19.2 million people) had not smoked for at least 1 day because they were trying to quit the habit (Ref 13). Several characteristics of smokers in the military mirror those of their civilian counterparts.

2.2 Cigarette Smoking in the Armed Forces

2.2.1 Cigarette Smoking Prevalence Among Active Duty Military Members. Cigarette usage in the military has been decreasing over the past 20 years. According to the 2005 DoD Survey of Health Related Behaviors, the prevalence of any smoking was 32.2%, with any smoking defined as any cigarette use in the past 30 days, while heavy smoking is defined as one pack or more a day. This is a decline from the 1980 survey (prevalence 51.0%) but an increase from 2002, possibly due to the terrorist attacks of September 11, 2001, and the subsequent dramatic increase in operations tempo (Ref 14). The branch of service with the lowest "any smoking" prevalence was the Air Force, with 23.3%. Heavy smoking (smoking a pack per day or more) also declined within the DoD from 1980 to 2005, from 34.2% to 11.0%. As with any smoking, the service with the lowest heavy smoking prevalence was the Air Force, with 7.0%. This general decreasing trend of smoking mirrors the nonmilitary decrease in smoking over the past 25 years. Likewise, the military parallels its civilian counterparts in other areas as well (Ref 14).

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2.2.2 Basic Demographics of Cigarette Smokers in the Military. In general, the basic demographic characteristics (gender, education, paygrade, residence, and marital status) of smokers in the military are similar to nonmilitary smokers. First, males are more likely to smoke than females. Second, smoking rates are lower among those with higher levels of education and higher paygrade. Third, those members stationed outside the contiguous U.S. are more likely to smoke than those stationed in the U.S. Finally, married individuals living with their spouse are less likely to smoke than those who are married but not living with their spouse or who are not married (Ref 14).

2.2.3 Cost of Cigarette Smokers in the Military. Smoking-related health-care costs in the DoD are estimated at about $530 million a year. Associated lost productivity costs are approximately $345 million a year (Ref 15). In general, smokers reported more productivity loss than nonsmokers on the 2005 DoD HRB survey. This correlation, however, is weak. A stronger association was found in the analysis of the 1985 Worldwide Survey of Alcohol and Nonmedical Drug Use Among Military Personnel. Among other findings, the investigators found more poor health outcomes, such as increased physician visits and increased number of illnesses, among individuals who smoked 1.5 packs of cigarettes or more a day when compared to nonsmokers (Ref 16). In addition, the deleterious impact of smoking on stamina and performance is well documented. These considerations are important given the nature of military service (Ref 17).

2.2.4 Cigarette Smokers in the Military and Their Attempts to Stop. An important aspect of analyzing smoking behavior is the number of attempts to stop. This information can help guide the development of smoking policies, programs, and cessation strategies. Within the DoD, among all personnel, 19.6% tried to stop smoking in the past 12 months, while 12.3% did not try to stop smoking. Among smokers, 14.0% quit smoking within the past year, 52.8% tried to quit smoking but continued, and 33.2% did not try to quit smoking. Overall, 66.8% of military smokers tried to quit in the past year (Ref 14). Attempts to stop, military smoking prevalence, and basic demographics are all important facets of military smokers. Another key facet is the historic tobacco culture within the military.

2.2.5 Tobacco Culture in the Military. There are significant cultural ties between tobacco usage and military service dating back to the early 20th century. Newspaper advertisements depicted and glamorized servicemen smoking during World War II and the Korean War. Also during that time period, cigarettes were included in C-rations (individual canned and prepared wet ration) and K-rations (survival ration) (Ref 18). Many young recruits started to smoke immediately after joining the military during their initial basic military training. During this training, "smoke breaks" were often used as both reward and punishment (Ref 19).

In the 1980s, the DoD initiated health promotions measures to improve health and readiness to include decreasing the smoking prevalence of its service members (Ref 20). The DoD banned smoking in all military buildings in 1994 (Ref 21). In 2001, the DoD prohibited tobacco use of any kind during basic military training (Ref 21). And yet, despite all these restrictions, the Department of Defense continues contradictory policies. For instance, discounted cigarettes are still readily available at on-base (on-post) commissaries and exchanges. It is estimated that commissaries total about $458 million in tobacco sales a year (Ref 15). In addition to the tobacco culture, there are many contributors to the continued use of cigarettes

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despite the known consequences. One of these contributors is the mental health status of the smoker.

2.3 Mental Health Status and Cigarette Smoking

2.3.1 Mental Disorders in the United States. Mental disorders are a common ailment in the U.S. It is estimated that approximately one in four adult (18 years old and older) Americans are afflicted with a diagnosable mental disorder, in other words, 57.7 million people when using 2000 U.S. Census numbers. Of those, 45% meet the diagnostic criteria for two or more mental disorders; the severity of these conditions is strongly associated with comorbidity. Almost 30 million (20.9) Americans suffer from major depressive disorder, or 9.5% of adults. Forty million adults suffer from anxiety disorders, or 18.1% of people in this age group. In this same population, 7.7 million adults (3.5%) suffer from post-traumatic stress disorder. Also, mental disorders are the leading cause of disability in the U.S. for individuals 18-44 years old (Ref 22).

2.3.2 Mental Disorders in the Military. Approximately 18% of respondents to the 2005 HRB survey indicated a perceived need for mental health care within the past 12 months, with approximately 15% receiving that care. An extremely important population within the military is those who have deployed, especially given the current combat operations in Iraq and Afghanistan. Data from the Post-Deployment Health Re-Assessment (PDHRA) show 38% of soldiers and 31% of Marines report psychological symptoms. This assessment is administered to military members 90 to 120 days after returning from a deployment (Ref 23). Mental disorders appear to be the most important source of medical and occupational morbidity in active duty military members (Ref 24). The medical morbidity secondary to mental health disorders likely includes an increased cigarette smoking prevalence.

2.3.3 Mental Disorders and Cigarette Smoking. Researchers have found high smoking rates in selected populations of people with mental illness. These populations include psychiatric outpatients as well as State mental hospital patients. Of all cigarette smokers, 44% are estimated to have a mental disorder (Ref 25). In 2000, Ismail, Sloggett, and De Stavola, using a prospective panel cohort design, studied 12,057 patients in Great Britain to determine if there was an association between common mental health disorders and cigarette usage. The evidence indirectly supports common mental disorders may have an enduring effect of increasing cigarette smoking a year later (Ref 26).

Anxiety disorders, as well as smoking behavior variables and alcohol abuse or dependence, are predictive of nicotine dependence. In this same study, the researchers showed nicotine-dependent smoking is distinct from nondependent smoking and their respective populations are characteristically different (Ref 27). Breslau, Novak, and Kessler concluded in 2004 that active preexisting psychogenic disorders predicted initial onset of smoking as well as transition to nicotine dependence (Ref 28). These conditions included major depression, anxiety disorders, and substance use disorders. Those who had four or more disorders were more at risk of daily smoking and nicotine dependence. Interestingly, nicotine has been used to treat mental disorders such as Parkinson's disease, Alzheimer's disease, attention deficit/hyperactivity disorder, Tourette's syndrome, and depression. Research is currently being conducted on selective neuronal acetylcholine receptors (Ref 12).

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2.4 Database and Survey Description

The 2005 DoD Survey of Health Related Behaviors Among Active Duty Military Personnel is a component of the Defense Lifestyle Assessment Program. This survey has been used by the DoD to collect information about the behavior and health readiness of active duty military personnel for over 20 years. The intent of conducting the survey and analyzing the results is to assist leaders in understanding substance abuse and health practices and subsequently develop effective programs and policies to maximize force readiness. The 2005 survey was the ninth in a series started in 1980. The survey is conducted by RTI International with the Office of the Assistant Secretary of Defense (Health Affairs).

The survey consists of questions used previously, augmented questions from previous surveys, and new questions. The areas covered include alcohol use, illicit drug use, tobacco use, and subsequent negative consequence of substance abuse. Other questions include topics from Healthy People 2000 and 2010 objectives, mental health, oral health, gambling behaviors, exercise, nutrition, dietary supplement use, risk taking, impulsive behavior, job satisfaction, deployment, and religiosity/spirituality.

Active duty military personnel total approximately 1.4 million people, with almost half between the ages of 22 and 30 years old. Fifteen percent are female. Roughly one quarter of the personnel are white, with African Americans making up almost 18% of the population. Fifty percent are married (Ref 29).

The eligible population for the survey consisted of all active duty military personnel with the following exceptions: members absent without official leave, members conducting a permanent change of station at the time of data collection, recruits, and service academy cadets. The final survey sample size was 16,146 members, with a response rate of 51.8%. The survey consisted of a self-administered questionnaire that was either completed in a group session at a military installation or mailed in upon completion for those not attending the sessions. The sample is representative of both male and female personnel of all paygrades. The data were weighted to represent all active duty members. Researchers performed weighted adjustments to account for nonrespondent bias based on branch of service, age, and race to maintain the representativeness of the sample. The sampling weights serve as inflation factors, making the respondents more representative of the total military population (Ref 14, Appendix B, p. 267).

3.0 METHODS

3.1 Study Design

This research project is an analysis of a cross-sectional prevalence study. It includes descriptive statistics, univariate analysis, and multivariate logistic regression analysis of the association between any cigarette smoking during the past 30 days and four main predictors: need for further depression evaluation, reception of mental health treatment in the past 12 months, perceived need for mental health counseling in the past 12 months, and prescription of medications for depression or anxiety.

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3.2 Study Population and Sample Size

The study population consisted of 16,146 active duty military members who responded to the 2005 DoD Survey of Health Related Behaviors Among Active Duty Military Personnel. The sample size consisted of 13,603 subjects after elimination of those individuals who did not have responses or had inappropriate responses (i.e., multiple responses in a single response question) to the survey questions being studied.

3.3 Mental Health Primary Predictors

The four main predictors include two recoded variables and two survey questions. The composite indicator for the first predictor, "may have a need for further depression evaluation," is the recoded variable "depflag." The indicator for the second predictor, "received mental health counseling in the past 12 months," is the recoded variable "mhcouncil." These recodes were accomplished by the conductors of the HRB survey, the Research Triangle Institute.

The third predictor is from Question 103 in the HRB survey: "At any time in the past 12 months, did you feel you needed counseling or therapy from a mental health professional (either military or civilian) (Y/N)?" The fourth and final predictor is from Question 106: "Have you been prescribed medication for depression, anxiety, or sleeping problems by a doctor or other health care professional in the past 6 months (Y/N)?"

3.4 Outcome Variable: Any Smoking

The outcome variable is any smoking, which is defined as any cigarette use in the past 30 days. This variable (esmoke30) was recoded using two questions from the HRB survey, Questions 52 and 53. As above, this recode was accomplished by the conductors of the HRB survey, the Research Triangle Institute.

Question 52: When was the last time you smoked a cigarette?
    Today
    During the past 30 days
    5-8 weeks ago
    2-3 months ago
    4-6 months ago
    7-12 months ago
    1-3 years ago
    More than 3 years ago
    Never smoked cigarettes

Question 53: Think about the past 30 days. How many cigarettes did you usually smoke on a typical day?

    About 2 packs or more a day (more than 36 cigarettes)
    About 1½ packs a day (26-35 cigarettes)
    About 1 pack a day (16-25 cigarettes)
    About ½ pack a day (6-15 cigarettes)
    1-5 cigarettes a day
    Less than 1 cigarette a day, on the average 1-5 cigarettes a day
    Did not smoke any cigarettes in the past 30 days

3.5 Covariates

Researchers have determined several sociodemographic and occupational factors that affect cigarette smoking to include age, marital status, gender, paygrade, education level, deployment, and ethnicity (Ref 14). In addition, behavioral factors such as impulsivity, alcohol use, and exercise have been shown to affect cigarette smoking (Ref 27, 30).

Sociodemographic

- Gender – Male or Female
- Age – ≤20, 21-25, 26-34, ≥35
- Ethnicity – White non-Hispanic, Black non-Hispanic, Hispanic, Other
- Education – High school graduate or less, Some college, College graduate or more
- Marital status – Not married; Married, spouse not present; Married, spouse present

Occupational

- Service – Army, Navy, Marine Corps, Air Force
- Paygrade – Enlisted, Officer
- Deployment in past 3 years – Yes or No

Behavioral

- Impulsivity (defined as self-reported risk taking) – Yes or No
- Heavy drinker (defined as consumption of five or more drinks on the same occasion at least once a week in the past 30 days) – Yes or No
- Exercise (defined as moderate or vigorous exercise for at least 20 minutes a minimum of three times per week) – Yes or No

3.6 Statistics

Various statistical analyses were completed. Descriptive statistics of the four main predictors and the covariates were calculated using both unweighted and weighted samples. Univariate analysis was conducted between the outcome variable "any smoking" and the four mental health predictor variables. Percentages of any smoking among the mental health predictors were calculated also. Covariates were included in the multivariate analysis if they met

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two criteria. First, covariates must be associated with "any smoking" in unadjusted regression analysis (p≤0.25). Second, covariates could not be highly correlated with each other. There were two variables that were highly correlated with each other: education and paygrade. Due to the military nature of the population as well as the possible application of the results to Department of Defense organizations, paygrade was chosen for the multivariate analysis. The analysis was conducted using STATA© version 10.0 (STATA Corp., College Station, TX) as the statistical software program. Results were reported as odds ratios (ORs) with respective 95% confidence intervals (CIs).

3.7 Protection of Human Subjects

Extant data were used from the 2005 DoD Survey of Health Related Behaviors Among Active Duty Military Personnel. The public use file does not contain personal identifiers. The data are in the public domain and are available to researchers, clinicians, policy makers, and citizens. No interaction with respondents occurred. In addition, use of these data was approved by the U.S. Air Force Research Laboratory Institutional Review Board. "The voluntary, fully informed consent of the subjects used in this research was obtained as required by 32 CFR 219 and AFI 40-402."

3.8 Data Management and Protection

Electronic data obtained from the 2005 DoD Survey of Health Related Behaviors Among Active Duty Military Personnel were maintained on a password-protected computer database. Any data or analysis that was stored on a USB external mini-drive was also password-protected and maintained in a locked drawer when not in use. There are no personal identifiers associated with these data. The DoD survey data are a public use file available to the general public.

4.0 RESULTS

Sample characteristics can be found in Tables 1 and 2. Almost a third (31.7%) of the respondents smoked at least one cigarette in the past 30 days. Regarding mental health predictors, percentages varied. Twenty-two percent of respondents may have needed further depression evaluation. Approximately 17% received mental health counseling, while almost 18% felt they needed mental health counseling. Four and a half percent of respondents required medication for mental health symptoms. Most respondents were between the ages of 21 and 34 years old. White non-Hispanics consisted of 66% of this population. Forty-four percent had some college education, and most respondents were either not married (44.6%) or married with their spouse present at home (49.2%).

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Table 1. Sample Characteristics of the Outcome Variable Any Smoking and the Four Mental Health Predictors (n=13,603)[a]

Characteristic	Unweighted Sample	Weighted Sample	Weighted %[b]
Any Smoking in the Past 30 Days			
Yes	3,567	267,479	31.7
No	10,036	576,649	68.3
Mental Health Related (All Yes)			
Need Further Depression Evaluation	2,735	185,745	22.0
Received Mental Health Counseling	2,217	142,713	16.9
Perceived Need for Mental Health Counseling	2,420	151,328	17.9
Depression or Anxiety Prescription	734	38,101	4.5

[a]DoD Survey of Health Related Behaviors Among Active Duty Military Personnel.
[b]Percentages may not add up to 100 due to rounding.

Of the respective services, the Army has the highest percentage of smokers at 31.9%, with the Marine Corps having the lowest at 12.9%. Most of the respondents were enlisted (82.2%), and most had deployed at least once in the past 3 years (56.0%). A majority were "a little impulsive" (56.2%), 18.1% were heavy drinkers, and 22.9% did not exercise.

Univariate analysis can be found in Tables 3 and 4. All mental health predictors were associated with any cigarette smoking in the past 30 days, with a p-value of less than 0.001. Those respondents needing further depression evaluation were 82% more likely to have smoked a cigarette in the past 30 days (p<0.001). If respondents received mental health counseling in the past 12 months, they had a 67% increased likelihood of "any smoking." There was a 61% increased likelihood of smoking a cigarette in the past 30 days with those respondents who felt they needed mental health counseling. Lastly, those respondents who took medication for mental health symptoms were 60% more likely to have smoked a cigarette in the past 30 days.

Women were less likely to have had a cigarette in the past 30 days than men (OR=0.65, p<0.001). As the respondents aged, the likelihood of smoking decreased. However, the p-value for the 21-25 year olds was 0.730. Compared to white non-Hispanics, black non-Hispanics and Hispanics were less likely to smoke (OR=0.44, p<0.001; OR=0.70, p<0.001). The "Other" category in ethnicity was insignificant, with a p-value of 0.495. There is less likelihood of a respondent smoking if the respondent was married with the spouse present (OR=0.59, p<0.001). The "married with spouse not present" category was insignificant.

Respondents in the Army were more likely to have smoked in the past 30 days than respondents in the other services. Officers in all the services were less likely to be "any smokers" than enlisted personnel in all the services (OR=0.16, p<0.001). Respondents who had deployed at least once in the past 3 years were more likely to have smoked a cigarette in the past 30 days. Concerning behavioral characteristics, there was a progressive increase in the likelihood of smoking a cigarette in the past 30 days as impulsivity increased (a little impulsivity OR=1.87; some impulsivity OR=3.67; a lot of impulsivity OR=7.40; p<0.001). Heavy drinkers were over four times more likely to be an "any smoker," with an OR of 4.04 and p<0.001. Respondents who did not perform moderate or vigorous exercise for at least 20 minutes at least three times a week had an increased likelihood of being an "any smoker" (OR=1.09, p=0.228).

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Table 2. Sample Characteristics of Sociodemographic, Occupational, and Behavioral Covariates (n=13,603)[a]

Characteristic	Unweighted Sample	Weighted Sample	Weighted % [b]
Sociodemographic			
Gender (Female)	3,398	127,449	15.1
Age (yr)			
17-20	1,051	115,760	13.7
21-25	3,428	265,851	31.5
26-34	3,682	261,179	30.9
35+	5,442	201,338	23.8
Ethnicity			
White non-Hispanic	8,563	557,319	66.0
Black non-Hispanic	2,090	140,037	16.6
Hispanic	1,624	72,797	8.6
Other	1,326	73,975	8.8
Education			
High school or less	3,412	272,772	32.3
Some college	5,941	374,314	44.3
College or more	4,250	197,042	23.3
Marital Status			
Not married	5,039	376,491	44.6
Married, spouse not present	1,048	52,149	6.2
Married, spouse present	7,516	415,487	49.2
Occupational			
Service			
Army	3,041	269,343	31.9
Navy	3,794	219,971	26.2
Marine Corps	2,925	108,769	12.9
Air Force	3,843	246,044	29.1
Paygrade			
Enlisted	10,066	693,540	82.2
Officer	3,537	150,588	17.8
Deployment in Past 3 Yr (once or more)	7,914	472,591	56.0
Behavioral			
Impulsivity[c]			
Not at all	2,832	140,959	16.7
A little	7,854	474,272	56.2
Some	2,405	184,130	21.8
A lot	512	44,766	5.3
Heavy Drinker[d] (Yes)	2,014	152,894	18.1
Exercise[e] (No)	3,110	193,062	22.9

[a]DoD Survey of Health Related Behaviors Among Active Duty Military Personnel.
[b]Percentages may not add up to 100 due to rounding.
[c]Defined as self-reported risk taking.
[d]Defined as consumption of five or more drinks on the same occasion at least once a week in the past 30 days.
[e]Defined as moderate or vigorous exercise for at least 20 minutes a minimum of three times per week.

Table 3. Associations Between Mental Health Predictors and Any Cigarette Smoking in the Past 30 Days (n=13,603)[a]

Mental Health Variable	Any Smoking				
	%	Unadjusted Model OR (95% CI)	p-value	Adjusted Model[b] OR (95% CI)	p-value
Needed Further Depression Evaluation					
No	18.6	1.00		1.00	
Yes	29.4	1.82 (1.59-2.08)	<0.001	1.24 (1.08-1.43)	0.003
Received Mental Health Counseling					
No	14.5	1.00		1.00	
Yes	22.1	1.67 (1.49-1.88)	<0.001	1.42 (1.25-1.62)	<0.001
Perceived Need for Mental Health Counseling					
No	15.6	1.00		1.00	
Yes	23.0	1.61 (1.45-1.80)	<0.001	1.28 (1.13-1.45)	<0.001
Depression or Anxiety Prescription					
No	3.8	1.00		1.00	
Yes	6.0	1.60 (1.26-2.05)	<0.001	1.49 (1.15-2.92)	0.003

[a]Results obtained from four unadjusted models for each of the predictor variables and four adjusted models for each of the predictor variables.
[b]The adjusted model is adjusted for the covariates gender, age, ethnicity, marital status, service, paygrade, deployment in past 3 years, impulsivity, heavy drinking, and exercise.

Multivariate adjustment revealed continued association between the four mental health predictors and any smoking (Table 3). This adjustment included the covariates gender, age, ethnicity, marital status, service, paygrade, deployment in past 3 years, impulsivity, heavy drinking, and exercise. Those respondents needing further depression evaluation were 24% more likely to have smoked a cigarette in the past 30 days (p=0.003). There was a 42% increased likelihood of smoking a cigarette in the past 30 days with those respondents who received mental health counseling (p<0.001). If respondents felt they needed mental health counseling in the past 12 months, they had a 28% increased likelihood of any smoking (p<0.001). Lastly, those respondents who took medication for mental health symptoms were 49% more likely to have smoked a cigarette in the past 30 days (p=0.003).

A multivariate adjusted model for the mental health predictor "needed further depression evaluation" is included in Table 4. The significant covariates (p<0.05) are age, ethnicity, service, paygrade, deployment in the past 3 years, impulsivity, and heavy drinking. The adjusted associations of these covariates with any smoking trend in the same direction as the unadjusted associations. For example, non-Hispanic blacks were less likely to smoke a cigarette in the past 30 days than non-Hispanic whites, while officers were less likely to smoke a cigarette in the past 30 days than enlisted personnel. Also, those members who deployed were more likely to have smoked than those who did not deploy.

Table 4. Unadjusted and Adjusted Associations Between Covariates (Sociodemographic, Occupational, and Behavioral Characteristics) with Any Smoking (n=13,603)

Characteristic	Unadjusted Model		Adjusted Model[a]	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Sociodemographic				
Gender				
Male	1.00		1.00	
Female	0.65 (0.58-0.73)	<0.001	0.90 (0.79-1.03)	0.126
Age (yr)				
17-20	1.00		1.00	
21-25	0.97 (0.79-1.18)	0.730	0.96 (0.77-1.20)	0.718
26-34	0.57 (0.46-0.69)	<0.001	0.86 (0.67-1.10)	0.238
35+	0.28 (0.22-0.37)	<0.001	0.56 (0.41-0.77)	0.001
Ethnicity				
White non-Hispanic	1.00		1.00	
Black non-Hispanic	0.44 (0.38-0.51)	<0.001	0.44 (0.37-0.52)	<0.001
Hispanic	0.70 (0.59-0.85)	<0.001	0.53 (0.43-0.66)	<0.001
Other	0.94 (0.77-1.14)	0.495	0.91 (0.74-1.12)	0.368
Marital Status				
Not married	1.00		1.00	
Married, spouse not present	0.78 (0.59-1.02)	0.073	1.00 (0.78-1.28)	0.989
Married, spouse present	0.59 (0.49-0.70)	<0.001	1.02 (0.83-1.25)	0.851
Occupational				
Service				
Army	1.00		1.00	
Navy	0.75 (0.60-0.94)	0.012	0.78 (0.66-0.91)	0.003
Marine Corps	0.87 (0.69-1.09)	0.217	0.66 (0.53-0.82)	<0.001
Air Force	0.47 (0.37-0.60)	<0.001	0.57 (0.48-0.68)	<0.001
Paygrade				
Enlisted	1.00		1.00	
Officer	0.16 (0.13-0.20)	<0.001	0.20 (0.16-0.25)	<0.001
Deployment in Past 3 Yr				
No	1.00		1.00	
Once or more	1.32 (1.15-1.52)	<0.001	1.31 (1.17-1.47)	<0.001
Behavioral				
Impulsivity				
Not at all	1.00		1.00	
A little	1.87 (1.54-2.27)	<0.001	1.33 (1.08-1.65)	0.010
Some	3.67 (2.96-4.56)	<0.001	1.72 (1.32-2.24)	<0.001
A lot	7.40 (5.43-10.10)	<0.001	2.54 (1.82-3.55)	<0.001
Heavy Drinker				
No	1.00		1.00	
Yes	4.04 (3.39-4.83)	<0.001	2.67(2.28-3.11)	<0.001
Exercise				
Yes	1.00		1.00	
No	1.09 (0.94-1.27)	0.228	1.12 (0.95-1.31)	0.178

[a]Adjusted model compares any smoking with further depression screening. The three other primary predictors have similar results.

5.0 DISCUSSION

5.1 Main Results

There is an association between mental health predictors and any smoking after controlling for a wide range of covariates. Active duty military members who may have a need for further depression evaluation, who have received mental health counseling, who felt they needed mental health counseling, and/or who have been prescribed mental health medication are more likely to have smoked at least one cigarette in the past 30 days. This conclusion is consistent with previous literature.

5.2 Covariates of Interest

Two covariates of interest include deployment in the past 3 years and exercise. The increased likelihood of smoking in those active duty members who have deployed is consistent given the increased stresses involved in deploying. In contrast, one would surmise that there would be a significant association between not exercising and smoking. However, this was not the case (p=0.178). One possible explanation is the nature of military service requires a minimum level of physical fitness even among those in traditional "desk jobs."

5.3 Correlation to Previous Research

This study supports previous research on associations between mental health and cigarette smoking. Ismail, Sloggett, and Stavola in 2000 found that common mental disorders may have an enduring effect of increasing cigarette smoking a year later (Ref 26). A more recent study in 2004 showed active preexisting psychogenic disorders such as major depression, anxiety disorders, and substance use disorders predicted initial onset of smoking as well as transition to nicotine dependence (Ref 28). This association exists in both State mental hospital patient populations as well as psychiatric outpatient populations (Ref 25). Our research is consistent with these findings and with the seven pillars of epidemiological reasoning.

5.4 Seven Pillars of Epidemiological Reasoning

The tenants of epidemiological reasoning include coherence, biologic plausibility, strength of association, consistency, specificity, dose response, and temporal relationship (Ref 31). First, the results of this study are coherent with previous studies. This coherency holds true when mental health is used to predict cigarette use in nonmilitary populations and different subgroups of populations (e.g., psychiatric inpatients) as outlined in the introduction. Second, the associations are biologically plausible given the known central acting effects of nicotine on the pleasure centers of the brain. As stated in the background, research has been conducted on selective neuronal acetylcholine receptors by Mihailescu and Drucker-Colin (Ref 12). Third, the strength of association between these mental health predictors and cigarette smoking is not well established in this study as seen in the respective odds ratios. The most convincing predictor in the adjusted model is "depression or anxiety prescription," with an odds ratio of 1.49. However, it is important to note the 95% confidence interval is relatively wide, 1.15 to 2.92.

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Fourth, the results are consistent with other data. As mentioned in the introduction, data from the Ismail study (Ref 26) in Great Britain as well as the Breslau study in 2004 (Ref 28) show an association between mental health predictors and cigarette smoking. Fifth, this study does not indicate a high degree of specificity, since mental health diagnoses have several other sequelae in addition to increased cigarette smoking. These sequelae include other medical diagnoses as well as other mental diagnoses. Sixth, dose response is not established in this study due to the method of quantifying the outcome variable. The outcome was either yes or no to smoking at least one cigarette in the past 30 days. Seventh, temporal relationship cannot be established because this research analyzes data from a cross-sectional prevalence study.

In summary, this study meets three of the seven pillars of epidemiological reasoning: coherence, biologic plausibility, and consistency. Strength of association could be included when considering the predictor "depression or anxiety prescription." Despite this shortfall, the results of this research can be used to improve the health of the public.

5.5 Active Duty Public Health Significance

As stated in the background, mental disorders appear to be the most important source of medical and occupational morbidity in active duty military members according to Hoge et al. in their 2002 study (Ref 24). This medical morbidity secondary to mental health disorders likely includes an increased cigarette smoking prevalence. Therefore, the Department of Defense could decrease this morbidity by increasing support for effectively diagnosing and treating mental health patients as well as initiating smoking cessation programs and policy. This benefits not only the DoD but also the active duty members, their families, and society at large in two significant ways. First, decreased smoking and mental health diagnosis prevalence decrease the loss of productivity. Second, the cost of caring for illnesses secondary to these activities/diagnoses would be diminished.

5.6 Study Strengths and Limitations

This study has four main strengths. First, sample size is very large, which strengthens the stated associations. Second, the questions and responses have been validated in past DoD HRB surveys. Third, the results are consistent both internally and externally. In other words, the associations have the same trends, and the results are similar to previous studies. Lastly, the findings are applicable and can assist appropriate management functions in establishing funding priorities as well as focusing preventative public health actions.

There are three main weaknesses. First, the data are self-reported. Despite the validated questions, there still exists an element of error in the data itself. Second, causation cannot be determined since the DoD HRB survey is a cross-sectional prevalence study. Third, the study did not differentiate between the varying levels of cigarette use. Therefore, a dose response could not be established.

5.7 Future Research

There are three main areas where future research using the DoD HRB survey can be focused: (1) conducting a power analysis of the data, (2) investigating the association between mental health predictors and different amounts of cigarettes smoked to include heavy smokers

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(defined as smoking more than one pack per day), (3) determining if there is an association between different levels of alcohol consumption (i.e., binge drinking and occasional drinking) and cigarette smoking. Future research in general of this topic can include the development of a cohort study to determine any level of causation between mental disorders and cigarette usage.

6.0 CONCLUSIONS

This study shows there is an association between predictors of mental health and the outcome variable any smoking in active duty members of the U.S. Armed Forces. This is consistent with previous literature. These findings, as well as subsequent research, could be applied in the development of smoking prevention and cessation programs. Future research should include a more in-depth analysis of the DoD HRB survey data to determine if a dose response impacts the association of the variables.

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LIST OF ACRONYMS

CI   confidence interval

DoD   Department of Defense

HRB   health related behaviors

OR   odds ratio

PDHRA Post-Deployment Health Re-Assessment

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